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EP 0123562 A1

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UK CL (Edition K) **G4H HNP, G4Q QAJ**
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(54) Controlling vehicle movements

(57) Each vehicle in a fleet of taxicabs carries a computer (40) which is automatically supplied with input signals by a position detector (44) showing its instantaneous geographical location, and by a motion sensor (46) and other detectors (47 to 49). This information is processed by the computer to give an output signal transmitted through a radio modem (42) to a base station. A computer at the base station uses these output signals from the cabs, together with other relevant information supplied from control databases, to select the most suitable cab for making a proposed journey, details of which have been fed into the base station computer by an operator. The base computer then transmits to the selected cab a command signal which the vehicle computer (40) converts into printed instructions to the driver. In normal use, cab selection and the issuing of instructions to the driver are entirely automatic.

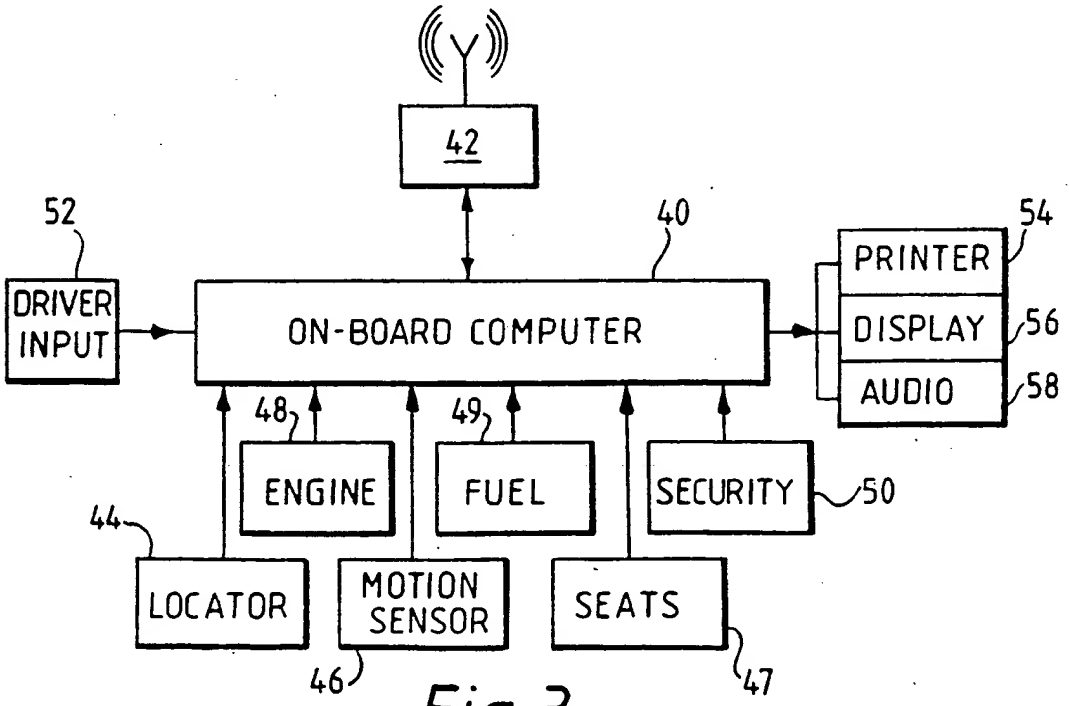

Fig.3.

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

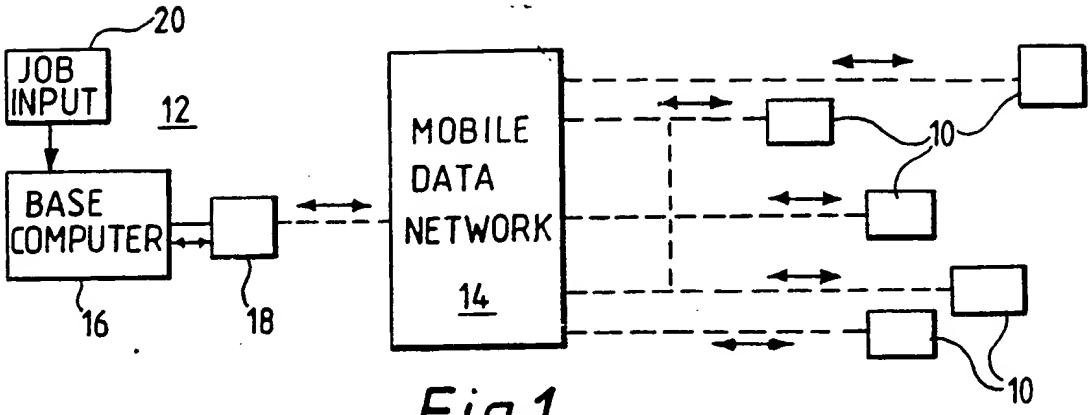

Fig.1.

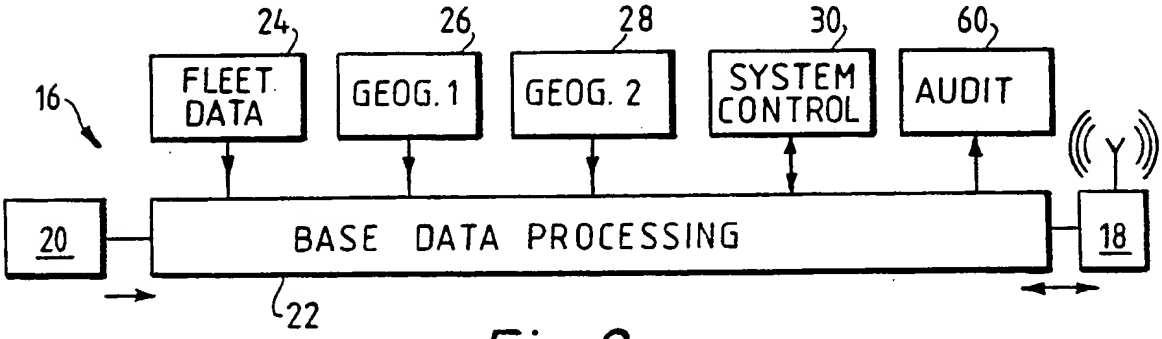

Fig.2.

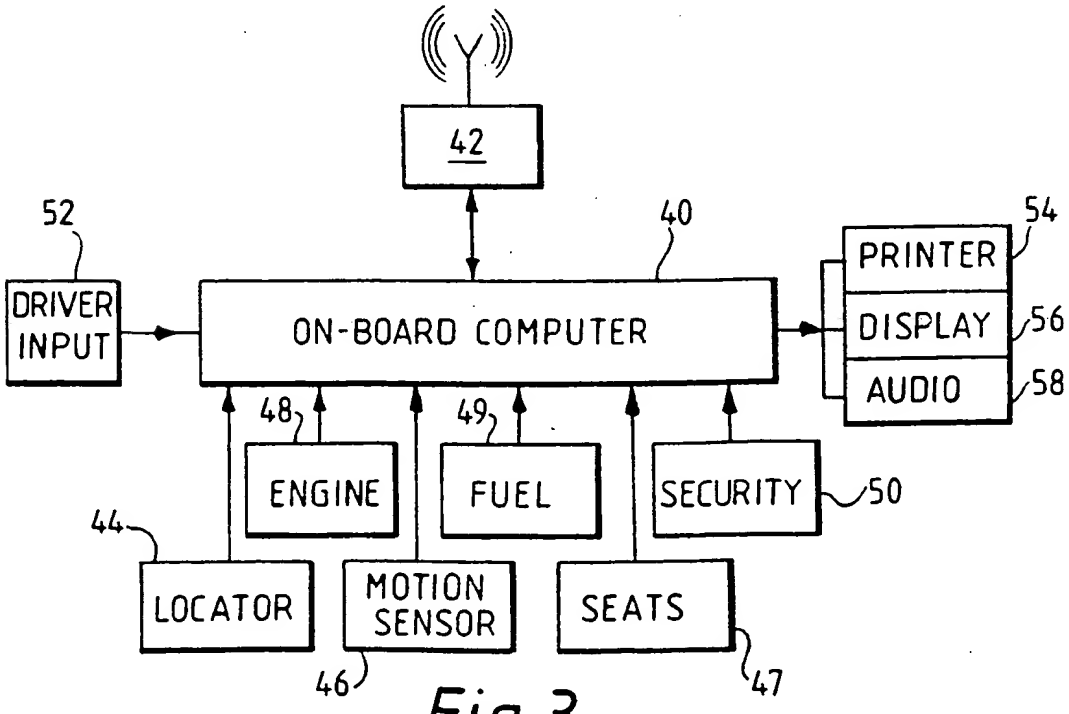

Fig.3.

METHOD AND APPARATUS FOR CONTROLLING VEHICLE MOVEMENTS

This invention relates to methods and apparatus for controlling vehicle movements from a base station. It is concerned with the situation in which a plurality of vehicles, each able to be operated independently, are required to be directed to make specific journeys, this direction being carried out from the base station.

A typical example of such a situation is where a fleet of taxicabs is scattered around a city, with each customer (referred to herein as the fare) ordering up a taxi by telephone to the base station. It is common to control fleets of taxis from the base station by word of mouth, via radio communication, with the drivers stating their locations and reporting that a fare has been picked up or set down, and the base station operator giving instructions to the drivers.

In practice this system is inefficient in terms of maximising the fare paying mileage of each cab and minimising the mileage that has to be driven without a fare being on board. The reasons for this are mainly related to the fact that the fleet operator (at the base station) seldom knows where his cabs are located at any given moment with sufficient accuracy to be able to select for a journey the one which is likely to be most suitable in terms of minimising non-fare-paying mileage. In particular, the operator may not even know for certain which cab is nearest to the place where the new fare wants to be collected. It is also found that human factors - not necessarily under the operator's control - can affect the decision of the operator to select a particular cab for a new journey.

In addition, although in general terms the cab nearest to the pick-up point will be the one that should be selected, the optimisation of the ratio of fare paying mileage to non-fare-paying mileage can often depend on other factors as well. Among these may be weather conditions, whether or not the cab is low on fuel and needs to stop to refuel (so that another cab further away might in fact reach the pick-up point more quickly), the likely length of the journey and the consequent question of whether the cab driver will run into an overtime period before the journey is finished; and so on.

The operator needs to make a very rapid decision when selecting a cab to instruct for a specific journey, and in practice he will not usually be aware of these other factors. Even if he is, not only would a high degree of skill be required to weigh up all the relevant factors, but the operator does not have time to do this. This is aggravated by the fact that he has to spend much of his time in verbal communication with each driver as well as with potential fares.

In practice therefore, selection depends only on the operator's assessment, based on information supplied by the drivers, of which cab is nearest to the required pick-up point.

It is therefore desirable to provide a system by which control of a fleet of taxicabs can be effected automatically and objectively, taking into account at least the most significant parameters involved, eliminating human factors as far as possible, and producing the most cost-effective operation consistent with supplying prompt service to the fares.

According to the invention in a first aspect, a method of controlling vehicle movements from a base station comprises:

- automatically supplying, to a vehicle computer on each of a plurality of vehicles, vehicle situation data defining at least the location of that vehicle;

- processing the situation data for each vehicle in the computer on board that vehicle, so as to produce a vehicle output signal in response thereto;

- transmitting the vehicle output signals automatically to a base computer at the base station;

- supplying the base computer with journey requisition input information defining a journey to be made by a vehicle;

- processing the vehicle output signals and requisition input information in the base computer so as automatically to select a suitable vehicle to make the journey; and

- transmitting a command signal, defining the journey, from the base computer to the selected vehicle.

In this method, once the computers have been suitably programmed, the only human intervention may be to feed the journey requisition input information, i.e. the requirements of the fare, telephoned to the base station, to the base computer; and of course the response of the driver of the cab in obedience to the information he is given in his vehicle as a result of the command signal being received. In this way the whole process is made essentially objective in character, by contrast with the

highly "subjective" existing systems with their continuous human intervention.

It will be realised that the process time between input of the requisition information and delivery of instructions to the driver may be only a matter of seconds, with all relevant factors being automatically taken into account in the selection of a vehicle. In addition the base operator is free to concentrate on receiving instructions from would-be fares and feeding them into his computer; and the drivers are relieved of the need for frequent reporting to the base station.

The method of the invention is not only applicable to fleets of taxicabs, but is applicable in many other contexts, including that of driverless vehicles in military or other applications such as in large warehouses or storage yards. Where at least one of the said vehicles is driver operated, command signals transmitted to that vehicle are converted by its onboard computer into driver readable form. In a driverless vehicle the computer can easily be arranged, in a known way, to control the vehicle directly.

Preferably, the situation data not only consists of mere information about the location of the vehicle, but further includes information relating to at least one of the following: state of motion of the vehicle; fuel level; seat occupancy; engine data; speed; presence or absence of an emergency; weather conditions.

Preferably, the vehicle situation and requisition signals are transmitted and received through a radio network. This may for example be a conventional two-way radio link, using a local, national or even an international radio network.

It will be appreciated that the transmission medium need not be radio, however: in some applications a suitable laser based communication system may be employed instead.

The communication link may include one or more relay stations, fixed or mobile; the means carried by the vehicles for transmitting and receiving signals need then have only such range as is sufficient to maintain communication with the nearest relay station.

It should be noted that using the system provided by this invention, even if the number of parameters represented in the vehicle situation data is quite large, this information is all processed on the vehicle itself, and the vehicle output signal can therefore readily be arranged to consist of a simple digital signal requiring a comparatively narrow bandwidth in the radio or other link between the vehicle and the base computer.

The base station need not be in a fixed position, but may be in an appropriate command vehicle.

According to the invention in a second aspect, apparatus for performing the method according to the first aspect of the invention comprises: the base computer; the vehicle computers; input means for entering the requisition input information to the base computer; means connected to the base computer for transmitting command signals and receiving vehicle output signals; and, carried by each vehicle, means for transmitting vehicle output signals and receiving command signals, means for enabling the command signals to be put into effect, and detector means connected to the vehicle computer for automatically supplying the latter with input signals representing at least the location of the vehicle.

The means for enabling the command signal to be put into effect, i.e. in the case of a driver-operated vehicle the means for informing the driver himself, preferably comprises a printer, though instead or in addition it may be in the form of a visual display unit, and/or a device for giving audible signals such as speech synthesised from the command signal in the onboard computer.

The detector means preferably comprise a location device for detecting the location of the vehicle in terms of geographical coordinates. In order to provide sufficient accuracy using known location devices of this kind, a vehicle motion sensor is also necessary.

The vehicles need not be road vehicles but, besides the examples quoted above, they may consist of any other land vehicles that are steerable at will. Indeed they may not even be land vehicles, for it can be seen that the invention would be applicable to the control of aircraft and boats, with suitable modification as to the parameters to be monitored automatically on board the vehicle and supplied as inputs to the onboard computer.

The invention is applicable not only to vehicles in the conventional sense of artefacts capable of locomotion. It can also be applied to the movements of persons per se, i.e. as pedestrians. Accordingly, wherever the context permits, the term "vehicle" is to be understood in this Application to have the special sense that it includes human beings. Thus a person to whom the invention is applied carries the various means listed above in the definition of the invention in its second aspect as being carried by a vehicle, together, of course, with a "vehicle" (or mobile) computer. It is a requirement that the detector means be sufficiently small and light to be

conveniently carried; the other means carried by the person can be combined in a single miniaturised unit using known technology. The transmitter/receiver unit carried by a pedestrian may be of relatively short range, for example in infantry or police use, the base station being in, for example, a vehicle such as a personnel carrier or police car.

One embodiment of the invention, directed specifically to the control of a fleet of taxicabs, will now be described by way of example only and with reference to the diagrams in the accompanying drawings, in which:-

Figure 1 represents the system as a whole;

Figure 2 is a process diagram for the apparatus at the base station; and

Figure 3 is a process diagram for the apparatus on board each taxicab.

In Figure 1, a fleet of taxicabs, some of which are indicated at 10, are controlled from the control centre or base station 12 through a mobile data network 14 using shortwave radio. The lines of radio communication are indicated in broken lines.

At the base station 12, a base computer 16 has a manned computer terminal 20 and a radio transmitting/receiving modem 18 to communicate with the network 14.

As indicated in Figure 2, the base computer 16 comprises a data processor 22 which processes information fed to it via the terminal 20, relating this information to information contained in a number of databases. In this example, these databases comprise a fleet data base 24, two geographical

databases 26 and 28, and a system control or management database 30. The fleet database 24 holds a list of all the vehicles 10, together with relevant details of the drivers (for example their names, normal working hours and so on), and any other information about the vehicles and/or their drivers that may affect the selection of a particular vehicle 10 to carry out a required journey.

The purpose of the geographical databases 26, 28 is to enable the system to identify the grid references for the pick-up and set-down points of the proposed journey, so that the routing algorithm performed by the data processor 22 can make the optimum selection of a taxi 10. Since few customers would be able to provide grid references themselves, these must be deduced from such information as the customer supplies to the operator at the base station. Typically this information will consists of an address (name of house, street number, street, and possibly postcode). On other occasions it may simply be a landmark, such as a war memorial, road junction, or even a bus stop the exact location of which is not known to the customer. The grid references therefore need to be obtained from a variety of different kinds of information and using more than one kind of database; and to this end, in the present example the database 26 is a postcode database, while the database 28 is in the form of a map expressed in digital terms. The postcode database typically contains the grid reference of each postcode (such a database is commercially available): while the map database typically enables the operator to see the relevant part of the map on a visual display unit at the terminal 20 and be able to identify the grid reference on it. The grid reference can then either be keyed in by the operator, or fed into the processor by any other known means.

As an alternative to the use of a map-based database 28, the operator may simply have an ordinary printed, large scale map, from which the required grid references can be keyed in by the operator.

The system control database 30 contains any administrative instructions for controlling and configuring the system itself. The base computer 16 is preferably an ordinary desktop computer. The information supplied by the operator through the terminal 20 is journey requisition input information defining the actual journey, and this is converted by the data processor 22 of the computer into a command signal, in digital form, which contains all the information necessary to enable the driver of the selected cab to proceed to the pick-up point, carry out the journey and accept payment from the fare.

The computer, when formulating the command signal, selects the most suitable cab to make the required journey, as will be explained below, and the command signal is transmitted via the modem 18 and network 14 to the selected cab 10. Preferably this is done in such a way that the command signal is received only by that cab. For this purpose, the command signal includes a selection element comprising a suitable code which is recognised only by the receiving unit (to which reference will be made below) of the appropriate cab, in such a way that the receiving units of the other cabs will not accept the command signal.

Referring now to Figure 3, each cab 10 carries an onboard vehicle computer 40, connected to an onboard receiving unit in the form of a radio transmitting/receiving modem 42, also carried by the cab. The cab also carries detector means connected to the computer 40 for automatically supplying the latter with input signals which represent at

least the geographical location of the vehicle at any time. In this example, this comprises a position detector or locator 44. Such devices are known per se and need not be described here, beyond stating that it is capable of automatically producing an output signal representing the coordinates of the instantaneous geographical location of the vehicle. This signal is continuously fed by the locator 44 as an input signal to the computer 40. The locator 44 may be of any suitable type.

In this example, however, the detector means also comprise a number of other detectors which automatically supply input signals to the computer 40 representing various parameters or states. In Figure 3, these consist of a motion sensor 46, a seat occupancy detector 47, engine condition detecting means 48, a fuel level detector 49, and a security or emergency device 50.

The motion sensor 46 detects whether the vehicle is in motion or not, and its output signal, besides indicating these two states, is preferably also such that it represents forward speed of travel as well. There may be a number of seat occupancy detectors 47, each in one of the passenger seats to indicate the number of passengers on board the cab, or the fact that there is no passenger as the case may be. A further seat occupancy detector may also be provided to show whether the driver is in the cab or not. The engine condition detecting means 48 may consist of a number of transducers, giving output signals representing such parameters as engine temperature, fuel flow rate, exhaust emission level, and so on. The fuel level detector 49 is arranged in the fuel tank. The security device or devices 50 may for example comprise a video camera, the computer 40 and modem 42 being so adapted, in known manner, that video signals from the

camera may be transmitted through the network 14 and modem 18 to a suitable video receiver at the base station, which may or may not also be the visual display unit of the terminal 20.

The computer 40 may optionally also have a further input from a keypad 52. This is operable by the driver for conveying messages to the base station when necessary, and particularly in an emergency. This keypad may be so arranged that, in the event of an attempted assault or other emergency, operation of a particular key automatically causes the picture transmitted by the video camera 50 to be displayed on the screen at the base station, together with all relevant information such as the identity of the cab and its exact location. The equipment at the base station may be arranged so that in that event, such an emergency signal from any one cab overrides all other information being received at the base station. If desired, it can also be arranged to activate an audible and/or visual alarm to alert the base station operator or the police.

Other detecting means may also be arranged to supply input signals to the onboard computer 40 in each cab. Without limitation, examples include rain and snow detectors and/or an ambient temperature sensor, since local weather conditions may affect the selection of a particular cab to carry out a required journey. Other external events, such as a road blocked because of an accident, can be taken account of by appropriate information being fed by the driver to the computer 40 through his keypad 52.

The information supplied automatically to the computer 40 by the various detectors discussed above, together with any information supplied by the driver via the keypad 52, is

processed by the onboard computer 40 and supplied by the latter as a continuous vehicle output signal to the modem 42, whence it is received through the network 14 by the modem 18 at the base station and fed to the base computer 16. The vehicle output signals from all the cabs 10 are processed by the computer 16 with the requisition input information supplied through the terminal 20 and the relevant information from the databases 24, 26, 28. The selection of a cab for a journey is made automatically by the computer on that basis.

Once this selection has been made, the command signal, transmitted to the selected cab as discussed above, is received in the cab via its modem 42 and processed by the computer 40, which drives a printer 54, Figure 3. This printer contains the instructions to the driver to make the journey, and may also include an instruction as what fare is to be charged, based on a calculation which can easily be done by the base computer 16 as to the estimated journey time and distance, and taking into account any other factors which may for example be incorporated in the system control database 30. The printer 54 may be supplemented or replaced by a visual display unit 56, and/or a synthesised voice unit 58 giving verbal information.

Figure 2 shows, connected to an output of the base data processor 22, a memory 60 in the form of an "audit trail", in which all required information about the operation of the system can be collected so as to provide a running journal of the activity of the fleet of cabs.

It will be understood that each onboard computer 40 can be designed in any suitable known way to perform the kind of functions described above. It will also be realised that, in general, and at least in the absence of an emergency,

all information other than the journey requisition information supplied by the operator at the base station is fed automatically to the base computer 16, which then automatically provides all instructions to the driver; and that the driver is not in verbal contact with the base station.

It will be appreciated that, with suitable detectors on each vehicle such as those indicated at 48 and 49 in Figure 3, and an audit trail facility, the mechanical performance, fuel consumption etc. of each vehicle can be continuously and automatically monitored, the information so accumulated being then used for vehicle maintenance and repair purposes. This facility also helps to give early warning of vehicle faults, and affords an advantage in the application of the invention over and above its other advantages, e.g. those of rapid and correct selection of the optimum vehicle for a particular journey and reduction of non-fare-paying or non-working mileage.

CLAIMS

1. A method of controlling vehicle movements from a base station, comprising:

- automatically supplying, to a vehicle computer on each of a plurality of vehicles, vehicle situation data defining at least the location of that vehicle;

- processing the situation data for each vehicle in the computer on board that vehicle, so as to produce a vehicle output signal in response thereto;

- transmitting the vehicle output signals automatically to a base computer at the base station;

- supplying the base computer with journey requisition input information defining a journey to be made by a vehicle;

- processing the vehicle output signals and requisition input information in the base computer so as automatically to select a suitable vehicle to make the journey; and

- transmitting a command signal, defining the journey, from the base computer to the selected vehicle.

2. A method according to Claim 1, wherein at least one said vehicle is driver-operated, command signals transmitted to that vehicle being converted by its on-board computer into driver-readable form.

3. A method according to Claim 1 or Claim 2, wherein the situation data further includes information relating to at least one of the following: state of motion of the vehicle; seat occupancy; fuel level; engine data;

speed; presence or absence of an emergency; weather conditions.

4. A method according to any one of the preceding Claims, wherein the base computer relates the requisition input information to data supplied from at least one database, comprising geographical data whereby geographical elements of the command signal are expressed in terms of position coordinates.

5. A method according to any one of the preceding Claims, wherein the vehicle situation and requisition signals are transmitted and received through a radio network.

6. Apparatus for performing the method of any one of the preceding Claims, comprising: the base computer; the vehicle computers; input means for entering the requisition input information to the base computer; means connected to the base computer for transmitting command signals and receiving vehicle output signals; and, carried by each vehicle, means for transmitting vehicle output signals and receiving command signals, means for enabling the command signals to be put into effect, and detector means connected to the vehicle computer for automatically supplying the latter with input signals representing at least the location of the vehicle.

7. Apparatus according to Claim 6, wherein the means for enabling the command signal to be put into effect comprise means for informing a driver of the vehicle.

8. Apparatus according to Claim 7, wherein the means for informing the driver comprise a printer.

9. Apparatus according to any one of Claims 6 to 8, wherein the detector means comprise a location device for

detecting the location of the vehicle in terms of geographical coordinates.

10. Apparatus according to Claim 9, wherein the detector means further consist of, or include at least one device selected from, the following: a vehicle motion sensor; a speed sensor; a fuel level sensor; at least one sensor for sensing an operating parameter of the engine of the vehicle; at least one sensor for detecting whether a seat in the vehicle is occupied; a security camera; a rain or snow detector; an ambient temperature sensor.

11. Apparatus according to any one of Claims 6 to 10, further including, in at least one said vehicle (being a driver-operated vehicle), input means connected to the vehicle computer for enabling the driver to supply information to the latter for transmission in the vehicle output signals.

12. A method of controlling vehicle movements, substantially as described in the foregoing description with reference to the accompanying drawings.

13. Apparatus for performing the method of any one of Claims 1 to 5 or Claim 12, substantially as described in the foregoing description with reference to the accompanying drawings.

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Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

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(ii) Int Cl (Edition 5) G08G

Search Examiner

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Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

15 JANUARY 1992

Documents considered relevant following a search in respect of claims 1-13

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	EP 0123562 A1 (BRITISH TELECOM) whole document	1-13

SF2(p)

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Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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P: Document published on or after the declared priority date but before the filing date of the present application.

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